2006

Putting Humpty Dumpty Back Together: Experimental Evidence of Anticommons Tragedies

Ben Depoorter
UC Hastings College of the Law, depoorter@uchastings.edu

Sven Vanneste

Author: Ben Depoorter

Source: Journal of Law, Economics & Policy

Citation: 3 J.L. ECON. & POL'Y 1 (2006).

Title: *Putting Humpty Dumpty Back Together: Experimental Evidence of Anticommons Tragedies*

PUTTING HUMPTY DUMPTY BACK TOGETHER: EXPERIMENTAL EVIDENCE OF ANTICOMMONS TRAGEDIES

*Ben Depoorter & Sven Vanneste**

ABSTRACT

This Article conducts an experimental investigation of anticommons dilemmas. The results confirm that anticommons deadweight losses increase with the degree of complementarity and the degree of fragmentation of property. Our study further provides three novel insights into the problem of fragmentation. First, the data illustrates that individual right holders ignore the expected value of bundling and instead focus on the maximum profit he or she could realize by bundling. Second, the experiments suggest that uncertainty amplifies the anticommons pricing effect. Finally, cooperation is higher in cases where the value of bundling is more uncertain as opposed to scenarios where there is relative certainty of creating surplus but there is a (modest) chance of losses from bundling.

1. INTRODUCTION

An anticommons is a property regime in which multiple owners hold effective rights of exclusion in a scarce resource.[1] Economic theory has illustrated how the coexistence of multiple exclusion rights may lead to sub-optimal uses of resources held in common.[2] If a common resource is

---

* Ben Depoorter is associate professor at University of Miami School of Law and Ghent University Law School. Sven Vanneste is research fellow at Ghent University, Faculty of Psychology, Dept. of Developmental, Personality & Social Psychology and visiting scholar Ghent University School of Law, Center for Advanced Studies in Law and Economics.

[1] This definition of the anticommons, employed by Heller, provides a powerful tool for property theory. Heller first revitalized the concept in an article on the transition to market institutions in contemporary Russia. He discusses the intriguing prevalence of empty storefronts in Moscow. Storefronts in Moscow are subject to under use because there are too many owners (local, regional and federal government agencies, mafia, etc.) holding the right to exclude. *See* Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621 (1998). The title of this paper refers to the fairy tale of Humpty Dumpty to illustrate the anticommons. When Humpty Dumpty is shattered into pieces all of the king's horses and all of the king's men cannot re-assemble him, which stands in contrast to the ease with which he broke into pieces in the first place. *See* Michael A. Heller, *The Boundaries of Private Property*, 108 YALE L. J. 1163 (1999).

[2] Anticommons theory relies on Cournot's model of duopoly: a single monopolist producing a composite good will charge a price lower than the sum of the prices that would be charged by two

subject to multiple exclusion rights held by two or more individuals, each co-owner has incentives to withhold resources from other users to an inefficient level. As a result, exclusion rights will be exercised even when the use of the common resource by one party could yield net social benefits, a problem known as the "Tragedy of the Anticommons."[3] Take the example of medical innovation. It is generally understood that awarding private property rights to discoveries promotes innovation and the commercial development of new technologies.[4] In light of the anticommons, intellectual property rights to research may actually retard life-saving developments of medical products when each owner of various stages of research block each other from the use of his research in creating these products.[5] The tragedy of the anticommons may occur because the multiple holders of exclusion rights do not fully internalize the cost created by the enforcement of their right to exclude others.[6]

The intuition underlying the anticommons is that it is often harder to regenerate separated bundles than it is to fragmentize.[7] Economic models assume the costs to rebundle independently-owned property fragments are higher than the costs involved in the initial fragmentation. Such "stickiness" of fragmentation is problematic when the costs of bundling prevent value-maximizing uses of the resource. When a value-enhancing opportunity arises which requires the unification of each fragmented right, the ex-ante rational decision to fragment may turn out to be ex-post sub-

---

complementary duopolists selling the single component parts. AUGUST COURNOT, RESEARCHES INTO THE MATHEMATICAL PRINCIPLES OF THE THEORY OF WEALTH (1838).

[3] The pioneering articles include: Heller, *The Tragedy of the Anticommons*, *supra* note 1; Heller, *The Boundaries of Private Property*, *supra* note 1; Michael E. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCI. MAG. 698 (1998), *excerpted as Upstream Patents = Downstream Bottlenecks*, 41 Law Quad. Notes, 93-7 (1998). The concept of the tragedy of the anticommons was formalized in James Buchanan & Yong J. Yoon, *Symmetric Tragedies: Commons and Anticommons Property*, 43 J. L. & ECON. 1, 1-13 (2000); Norbert Schulz et al., *Fragmentation in Property: Towards a General Model*, 158 J. INSTITUTIONAL & THEORETICAL ECON. 594 (2002); Francesco Parisi, et al., *Duality in Property: Commons and Anticommons*, 25 INT'L REV. L. & ECON. 578 (2005).

[4] *See* Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265 (1977).

[5] Heller & Eisenberg, *supra* note 3, at 698: "more intellectual property rights may lead paradoxically to fewer useful products for improving human health." For an empirical investigation, *see* John P. Walsh et al., *Working Through the Patent Problem*, 299 SCI. MAG. 1021 (2003) (providing survey evidence of the anticommons problem and the creativity of innovators in solving the problem).

[6] *But see, e.g.*, Richard A. Epstein & Bruce Kuhlik, *Is there a Biomedical Anticommons?*, 27 REG. 54 (2004) (arguing that researchers have ample incentives to solve anticommons problems in the biomedical field).

[7] In the words of Heller: "Once an anticommons emerges, collecting rights into usable private property may prove to be brutal and slow." Michael A. Heller, *Three Faces of Private Property*, 79 OR. L. REV. 417, 418, 424 (2000).

optimal, given the greater costs of reunification.[8] Prior theoretical research on anticommons fragmentation further suggests that the severity of the deadweight losses from concurrent possession of a complementary right increases monotonically with the number of independent holders.[9]

Despite these theoretical underpinnings, the literature to date has omitted analysis of the precise factors that lead reunification efforts to fail. Are negotiations unsuccessful because of transaction costs and strategic behavior, or is the bargaining process troubled by cognitive error? What social and cognitive processes lie at the root of the anticommons problem? In what way does non-cooperation in anticommons dilemmas differ from the well-known tragedy of the commons? Because empirical evidence on anticommons tragedies is hard to obtain directly,[10] analysis of the processes that create anticommons tragedies is especially important.

This Article sets out to deepen our understanding of the anticommons problem by conducting a number of social dilemma experiments in a laboratory setting. We measure the impact of various aspects of property fragmentation and provide an interpretation of the social and cognitive processes that might cause problems of reunification. We examine a number of alleged attributing factors of anticommons tragedies that have been highlighted in the theoretical literature.[11] These factors include the complementarity of fragmented parts, the number of fragmented parts, and the degree of uncertainty in obtaining value from rebundling fragmented ownership.

The results confirm the theoretical proposition that anticommons deadweight losses increase with the degree of complementarity between individual parts and with the degree of fragmentation. Our study further provides three novel insights into the problem of fragmentation. First, the data illustrates that each individual right holder ignores the expected value of the purchaser's project, and instead focuses on the maximum profit he could possibly realize by bundling. Second, the experiments suggest uncertainty amplifies the anticommons pricing effect. Finally, cooperation is higher in cases when the value of bundling is more uncertain, as opposed

---

[8] Schulz et al., *Fragmentation in Property: Towards a General Model*, *supra* note 3.

[9] Ben Depoorter & Francesco Parisi, *Fair Use and Copyright Protection: A Price Theory Explanation*, 21 INT'L REV. L. & ECON. 453, 460-61 (2002): "The greater the number of individuals who can independently price an essential input, the higher the equilibrium price that each of these individuals will demand for his own license. At the margin, as the number of [right] holders approaches very large numbers (or infinity), complete abandonment of valuable resources will result."

[10] Underuse and missed opportunities are not as easily observed as are, for instance, visually apparent commons tragedies of overuse. Evidence of anticommons tragedies, for instance, of research avenues forsaken due to licensing bottlenecks, must be observed indirectly through survey evidence. For an example of empirical research on anticommons tragedies in the biomedical field, *see* Cohen et al., *supra* note 5.

[11] Heller, *supra* note 7, at 4. *See also* Parisi et al., *Duality in Property: Commons and Anticommons*, *supra* note 3.

to scenarios where there is a relative certainty of creating surplus but a (modest) chance of loss from bundling.

Our experiment demonstrates the burden of negotiation that rests with a buyer who seeks to rebundle independently-owned property fragments. The results indicate the price concessions a prospective seller will need to obtain to bring the price of bundling within the limits of the net expected value of bundling.

Section 2 describes the structure of the experiment. Section 3 presents the results of our experiment. Section 4 provides a discussion of the results. Section 5 summarizes our conclusions.

2. DESCRIPTION OF THE STUDY

An anticommons is characterized by a conflict between private incentives of the various right holders and their common interest. Although an individual right holder should take into account the cross-effects of his pricing decision in order to safeguard successful reunification, he has a conflicting incentive to try and obtain as much as possible from the surplus that results from the process of bundling the individual parts. This divergence between private and public interests creates the "social dilemma" that lies at the heart of anticommons regimes.[12]

In our experiment, each participant[13] was informed in a script that he or she was one of five partial right-holders (owners) to a unitary resource.[14] In each of the scenarios, participants were informed that a third-party was looking to purchase a number of parts under the terms described in the particulars of the sub-experiment. Each participant further learned that he possessed an individual piece of land worth fifty chips (each chip being the equivalent of .05 euros), which he could cash in at the end of the experiment in return for his right. If he sold his individual right in return for chips from the bundler-purchaser, he would be able to return these chips at the end of the experiment for the money equivalent. After explaining the scenario, some comprehension questions were asked to verify that participants understood the situation. All participants answered these questions correctly.

---

[12] In a social dilemma: (1) a non-cooperative choice is always more profitable to the individual than a cooperative choice, regardless of the cooperativeness of others; (2) a non-cooperative choice is always harmful to others compared to a cooperative choice; and (3) the aggregate amount of harm done to others by a non-cooperative choice is greater than the individual's profit. *See* SHIRLI KOPELMAN ET AL. *Factors Influencing Cooperation In Commons Dilemmas: A Review Of Experimental Psychological Research*, *in* THE DRAMA OF THE COMMONS, 113–156 (Elinor Ostrom et al. eds., Nat'l Acad. Press 2002).

[13] We surveyed 300 first-year undergraduate students at Ghent University in Belgium.

[14] No significant effect was found for age or gender.

Using different scenarios for each participant, as described below, we explore how respondents, as individual right-holders, demand different prices when the following independent variables vary: 1) the degree of complementarity among fragmented parts; 2) the number of other rights holders with complementary rights to the resource; 3) the synergy resulting from fragmentation; and 4) the degree of uncertainty of the surplus obtained by bundling each of the individual rights.

The questions in the script were ordered randomly to avoid learning experiences.[15] The experiments were conducted in various different rooms to prevent participants from communicating or learning each other's reservation prices. The experiment was designed to measure the statistical data on a parametrical level. To this purpose, we used a multivariate repeated measure ANOVA.[16] Two sub-experiments deviate from this statistical method and were replaced by a one-way ANOVA to comply with the between-subject measurement format.[17]

3. RESULTS

3.1. *Surveys A and B: Complementarity*

Each participant[18] was informed that he or she was one of five partial right holders (owners) to a unitary resource. The participants were informed that a third-party was looking to purchase a number of parts. In the various parts of the test, the number of individual parts ranged between 2 and 5. Students were further informed that each individual part, by itself, had a market value of 50 euros.[19] The aggregate value of the unified bundle

---

15 When all subjects receive the script with questions in the same order, the first trial could influence their opinion in the second trial and so on. The learning effect is nullified when subjects receive the scripts in random order.

16 This involves the application of the analysis of variance to data in which a single dependent variable is measured on more than one occasion on the same subject. In the case of an orthogonal factorial design, the method essentially combines, in a linear fashion, the information of the several response variables in such away as to detect any existing treatment effects. *See* RICHARD A. JOHNSON, & DEAN W. WICHERN, APPLIED MULTIVARIATE STATISTICAL ANALYSIS (5th ed. 1998).

17 Various groups of participants were assigned to the different variables (2, 3, 4, or 5 parts) and every group had to decide on the price of the part assigned to them.

18 This study's population consists of a random group of first-year students of the departments of law, political science, and economics at Ghent University. Each student was randomly assigned to one of the experiments.

19 We operate from the stylized assumption that there is no difference between the market price of each individual part and the subjective value to each of the owners. In other words, we control for any idiosyncratic qualities of the parts or cognitive attachments to the parts, such as negative endowment effects. The cognitive effects involved in the decision-making process of rebundling are explored further on in this study.

was 250 euros. No further information on the incentives of the third-party (such as profitability and synergies resulting from bundling) was disclosed at this point. While this approach reduces the control of the experiment, relative to the other treatments in the surveys described below, this scenario is useful because it has more external validity by aligning more closely with real life anticommons situations where a third party purchaser (such as an oil company) tries to hide its identity or project in order to prevent inflation of prices. In the first hypothetical scenario, each student was informed that the purchaser sought to obtain 2 out of 5 parts that were divided among five participants. In a subsequent condition, other participants were informed that the purchaser needed to obtain 3, 4, or all 5 parts. In each of these scenarios, each participant listed his reservation price[20] while attempting to maximize his personal gain. The survey thus measures the differences in reservation prices arising in situations involving varying degrees of complementarity. Where the third party only looked to purchase two parts, this represents a relative low degree of complementarity, or, conversely, a case of relatively high substitutability.[21] By contrast, when the hypothetical scenario indicates the third party needed to purchase all five parts, this is a situation of perfect complementarity.

Parts	*Mean*	*Standard Deviation*	*N*
2	64.6	18.65	20
3	69.5	15.27	20
4	76.3	35.57	20
5	100.1	48.34	20

Table 1: Descriptive statistic, between subjects

Parts	*Mean*	*Standard Deviation*
2	67.4	19.57
3	72.6	26.38
4	80,2	36.12
5	107.1	57,99

Table 2: Descriptive statistic, within subjects (N = 20)

[20] We employ the term 'reservation price' to denote the initial selling price, as stated by the individual right holder. Strictly speaking this price is not necessarily a reservation price in that this stated price is the lowest outcome a negotiator is willing to accept. However, because there are no negotiations, we assume that initial right holders, in effect, will not accept an agreement that is below the initial selling price.

[21] *See* Depoorter & Parisi, *supra* note 9, at 460-61.

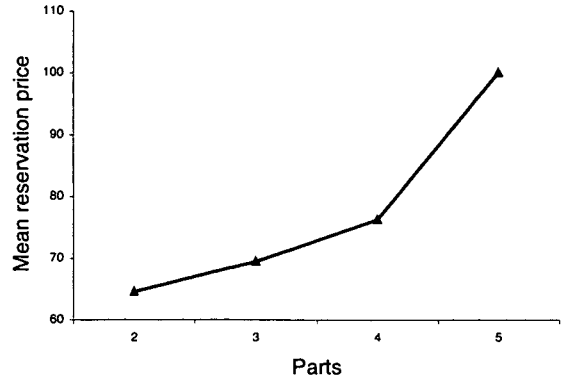

Figure 1: The mean demand price for the different parts measured between subjects (ANOVA, $F(3,76) = 4.73$, $p < .01$)

Table 1 and accompanying *Figure 1* map the variation between mean reservation prices. The mean demand price in the case of low complementarity was sixty-seven euros. The aggregate mean price was thus 134 euros; a total of thirty-four price units above the objective value of two combined parts. In the case of perfect complementarity, the mean demand price was 100 euros, totaling a mean demand price of 500 euros for the combined purchase of all individual parts. While reservation prices for "2 out of 5 complementarity" totaled 34% over the objective value, a case of perfect complementarity averaged a combined demand price that was 100% above the objective value. These simple findings confirm the theoretical finding that reservation prices correlate with the strength of the veto right into the successful bundling of the individual parts.

We repeated the same experiment, but measured repeatedly with the same subjects in each of the different conditions (2, 3, 4, and 5 parts) (between subjects). This measurement enabled us to verify whether subjects reasoned differently when they were asked to list a price in just one of the above scenarios, compared to situations where each individual subject was asked to formulate prices for all of the scenarios (within subjects).[22] The results—see *Table 2*—significantly correspond with the previously shown within-subject findings (Repeated Measure ANOVA, $F(3,17) = 5.42$, $p < .01$).

[22] When an experiment is conducted "within subjects," every participant is assigned to all treatments in a randomly selected order. In such experiment there is a risk that participants' selling prices differs according to the initial scenario (assembly of 2, 3, 4, or 5 required parts) first assigned to them. Such bias could be attributed to the initial scenarios working as a reference point in the mind of the participants. In such a case participants might not fully focus on the amount of parts the third party seeks to gather (degree of complementarity).

3.2. *Survey C: Opportunity Costs*

In Experiment *C*, we attached various degrees of profitability to the effort of rebundling by the third party. We measured the impact on the reservation prices of the individual right holders. As before, each participant (N = 84) was one of five partial right holders (owners) to a unitary resource. They were informed that a third-party was looking to purchase *all five parts* held by the individual owners. Again, each individual part had an objective value of fifty euros and the aggregate value of the unified bundle was 250 euros. By explicitly assigning the value of each right, we attempted to eliminate the "attribution effect" whereby each person systematically overvalues the role of his right in the overall project.[23]

Contrary to surveys *A* and *B*, we disclosed the opportunity costs of the third party upfront. Each participant was requested to state his demand price in each of five hypothetical scenarios *with varying profits to be obtained* by the third-party purchaser from bundling all five parts. In five different scenarios, each participant was informed that bundling would create a surplus for the third party of 100, 300, 500, 1000, or 10,000 euros. These scenarios each represent different values resulting from reunification. In the last hypothetical, the "sum is worth more than its parts" by 9,750 euros (10,000 – 250). In such a scenario, unsuccessful rebundling imposes considerable deadweight losses—as higher valued uses are not consummated. This situation represents a more significant anticommons tragedy relative to the first hypothetical, where a modest 100 euros was at stake in the effort to rebundle. *Figure 2*, plots the reservation prices in all five instances of surplus profitability. The vertical axis marks the asking price, expressed in relative amounts of the profits, or synergies of bundling. The horizontal axis indicates the cases of a third party profit of 100, 300, 500, 1000, 10,000 euros respectively. As *Figure 2* below indicates, there was no significant difference ($F(3,81) = 1.28, p = .168$) between reservation prices in the profit range between 300 and 10,000 euros; the average price stated by each right holder was approximately 26% of the total value of the surplus attained by bundling. In the case of a surplus of 10,000 euros, the purchaser was faced with an aggregate mean asking price of 12,300 euros. This price is 24.6% above the price that he or she can offer so that the project remains profitable. Similarly, when the profit from bundling was a

---

[23] The attribution bias holds that individuals systematically overvalue their assets and disparage the claims of their co-right holders. *See* LEE ROSS & CRAIG A. ANDERSON, *Shortcomings in the attribution process: On the Origins and Maintenance of Erroneous Social Assessments*, *in* JUDGMENT UNDER UNCERTAINTY: HEURISTICS AND BIASES, 129-52 (Daniel Kahneman et al. eds., Cambridge Univ. Press 1982). Heller and Eisenberg suggest that this particular cognitive bias explains bargaining breakdowns in the biotechnology industry, where scientists tend to overvalue the importance of their discoveries for the development of follow-up, aggregate inventions. *See* Heller & Eisenberg, *supra* note 3, at 701.

more modest 300 euros (plot 2 on graph 2, a median asking price was 26.6% or 79.8 euros per part), the combined reservation price was 399. Thus, the difference between reservation prices in the surplus range of 300 and 10,000 is non-significant.

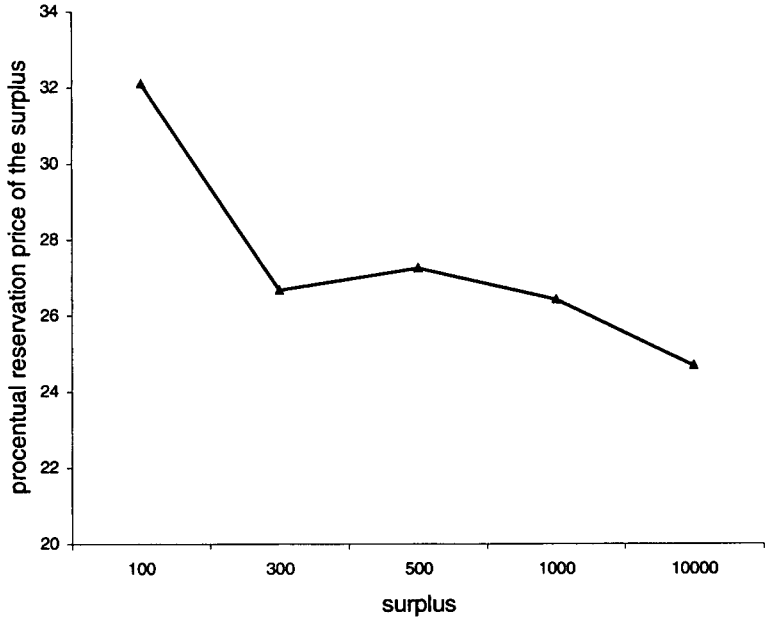

Figure 2: The degree of profitability from bundling of fragmented property entitlements on the prices charged by individual right holders ($F(4, 80) = 5.391$, $p < .001$)

3.3. *Survey D & E: Uncertainty*

Experiment *D* measures the effect of uncertainty regarding the expected benefits of the bundling of fragmented property entitlements. Again, each participant (N = 40) was informed that she was one of five partial-right holders (owners) to a unitary resource. A third-party was looking to purchase *all five parts* held by the individual owners. Each student was informed that each individual part had an objective value of fifty euros. The aggregate value of the unified bundle was 250 euros. As in Section 3, we disclosed the opportunity costs of the third party. This time, however, the subjects were informed that the purchaser faces considerable uncertainty as to the profitability of the project. Each participant was requested to state her reservation price in each of five hypothetical scenarios *with varying profits to be obtained by* the third-party purchaser

from bundling all five parts. Additional information was provided as to the uncertainty of the project's profitability. In four different scenarios, participants were informed that bundling would create a surplus for the third party of 100, 500, 1000, or 10,000 euros, each with a probability of 10%. In each of the scenarios, there would be a 90% chance that bundling did not create any surplus. The expected value of each of these projects was respectively 10, 50, 100, and 1000 euros. Are the subjects responsive to the lower expected value generated by the high degree of uncertainty? Again, the results give rise to pessimism. The results show that subjects consistently demanded a proportional share of 10% of the maximum profit that could possibly be realized by bundling. The mean reservation price, set by one individual right holder, was 14.25% of the surplus (see *Fig. 3*). Put differently, the aggregate reservation price was seven times above the expected value of the project ($F(3,37) = 20.31$, $p < .001$).[24] Given the expected benefit of the project (market value of the parts), the gap between purchaser's willingness to pay and individual owner's willingness to accept is non-negligible.

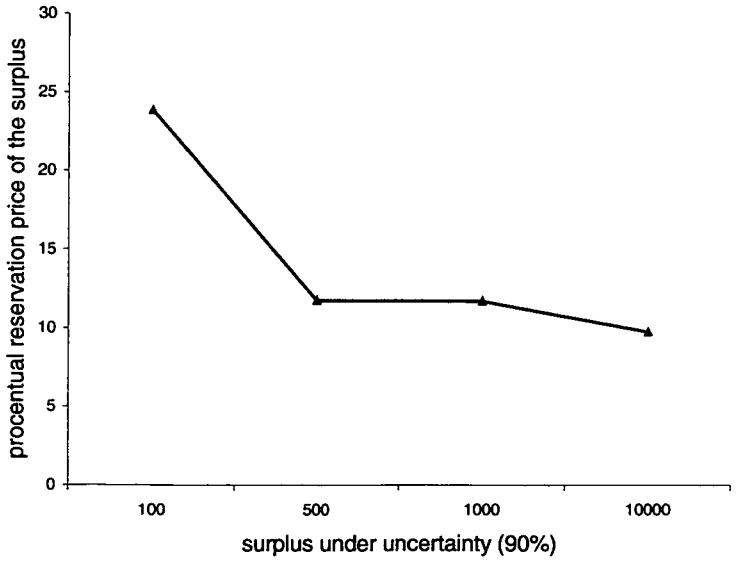

Figure 3: The expected profit of bundling the fragmented property under a 90% uncertainty for the individual holders. ($F(3,37) = 4.43$, $p < .01$)

[24] When there is certainty of 10% of surplus from bundling, every individual holders' maximum price is 2% of surplus. When individual right holders ask 14.25%, the aggregate price totals seven times the expected value of the projects. The statistical difference between the 2% case and the observed reservation prices ($F(3,37) = 20.31$, $p < .001$) is significant.

These results were confirmed in a second similar test (see *Figure 4*) when a higher degree of uncertainty is imposed: there is a 99% chance that bundling does not create any surplus. The expected value of each of these projects is respectively 1, 5, 10, and 100. Again, the subjects were unresponsive to the lower expected value generated by the high degree of uncertainty. From the results, subjects consistently demanded a proportional share of 11.44% of the maximum profit. The median price, set by one individual right holder, was fifty-seven times above the expected value of the project. The aggregate of the individual right holders' willingness to accept was fifty-seven times beyond the willingness to pay price of the purchaser, given the expected benefit of the project.[25]

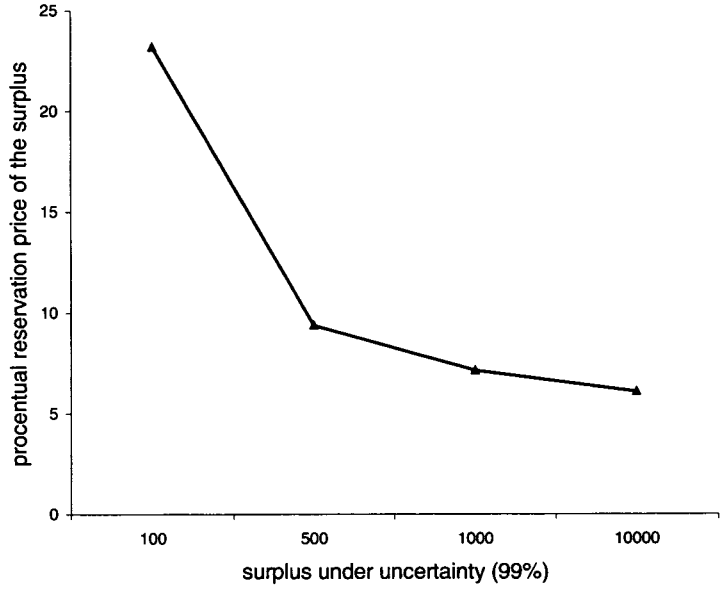

Figure 4: The expected profit of bundling the fragmented property under a 99% uncertainty for the individual holders. ($F(3,37) = 2.40$, $p < 0.05$)

Again, each subject (N = 78) was informed that he is one of the partial-right holders to a unitary source and that a third-party was interested in purchasing all five parts. Each individual part had a value of 50 euros and when the third-party bundles the five parts, this would generate a

[25] A similar deduction can be made as in footnote 21. When there is certainty of 1% of surplus from bundling, this means that every individual holders' maximum price is 0.2% of surplus. When individual right holders ask 11.44%, the aggregate price totals fifty-seven times the expected value of the projects.

surplus of 125 euros with a probability of 80% and a 20% probability of a loss of 450 euros. In two different scenarios, students were asked the same questions, but with a surplus of 1,250 or 12,500 and a loss of 4,500 or 45,000. The expected values of each of these projects were respectively, 10,100, and 1,000 euros.[26]

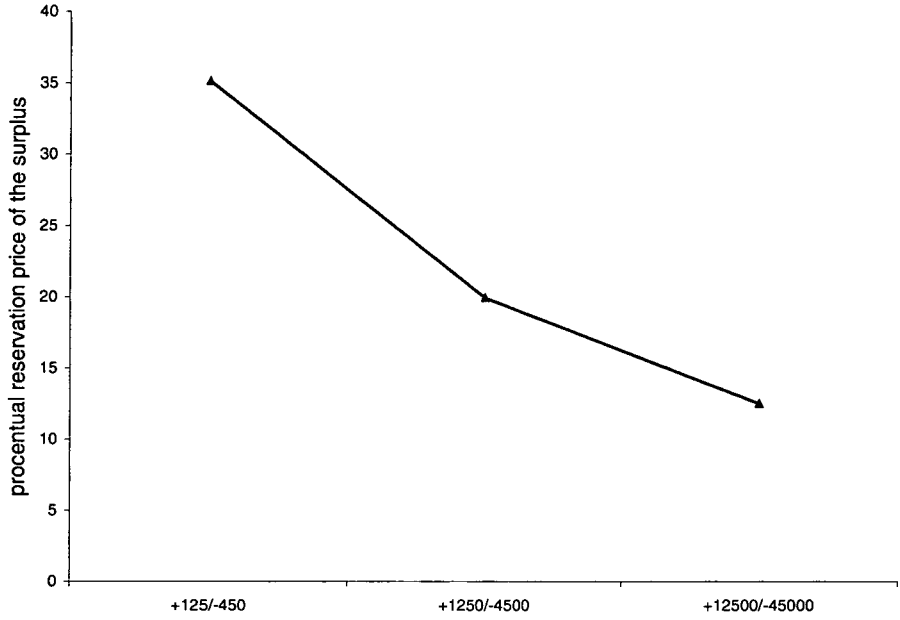

Figure 5: The expected profit of bundling the fragmented property for the holders under a 80% certainty of a surplus vs. 20% uncertainty of losing an amount of money for the purchaser. ($F(2,76) = 15.19$, $p < .001$)

Figure 5 confirms the findings of the other experiments. When stakes were minor, the individual right holders set disproportionately high reservation prices—35% in the case of a project with expected value of 100 euros (this totals a combined reservation price of 175% of the expected value of bundling). When stakes were higher, the average reservation price remained relatively stable at 14-19% of the expected surplus.

Next, we compared the reservation prices for two types of scenarios. Although the expected value of bundling was identical in both scenarios, one scenario promised high returns from bundling, but with great uncertainty, while the other scenarios promised only a more modest payoff

[26] A probability of 80% to win a surplus of 125 euros gives an expected value of 100 euros, while the chance of loss is 450 euros with a probability of 20%, giving us 90 euros. 100 euros minus 90 euros gives us an expected benefit of 10 euros.

to the third-party purchaser, but with higher certainty. In the case where bundling lead to a 100 dollar surplus with 10% probability, the mean reservation price was 24% of the expected value, compared to 35% of the expected value of the *low risk-low payoff* variant of experiment *E* ($F(2,75) = 9.44$, $p < .001$). In the case of a 1,000 dollar surplus with 10% probability in *D* (*high risk-high profit*), the mean reservation price was 12%, versus 19% in the *low risk-low profit* variant of *E* ($F(2,75) = 3.29$, $p < .05$). In the case of a 10,000 dollar surplus with 10% probability in *D* (high risk high payoff), the mean reservation price was 10%, versus 13% in the *low risk-low payoff* variant of *E (80% chance of +12,500 and 20% chance of -45,000).* Although the expected value in each of these scenarios was identical, reservation prices seem to be consistently lower (and cooperation higher) where there was considerable uncertainty regarding high returns than when there was relative certainty, but with a chance of losses for the third-party purchaser (See *Figure 6*, $F(2,75) = 4.92$, $p < .01$). Upon further examination, we find analogous results for instances where the surplus was 100 euros and 1,000 euros (see *Figure 7*) under high risk levels vs. low risk levels ($F(2,75) = 10.43$, $p < .001$).

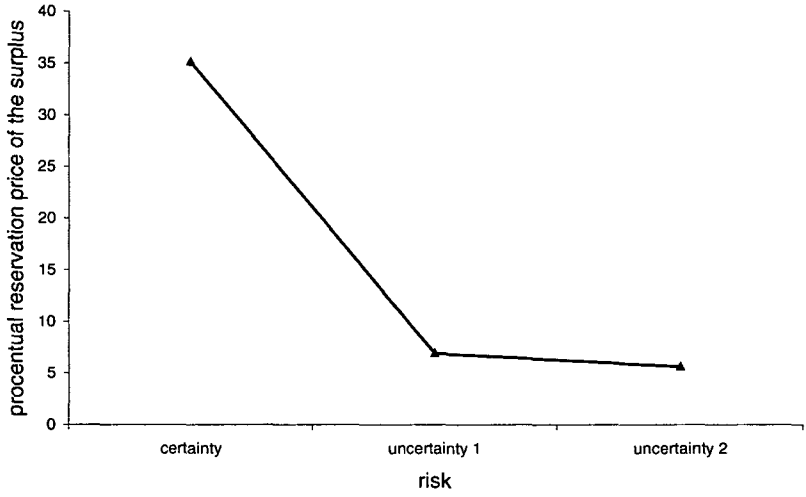

Figure 6: Different results for under certainty and uncertainty under identical expected surplus (10 euros) ($F(2,75)=4.92$, $p < .01$)

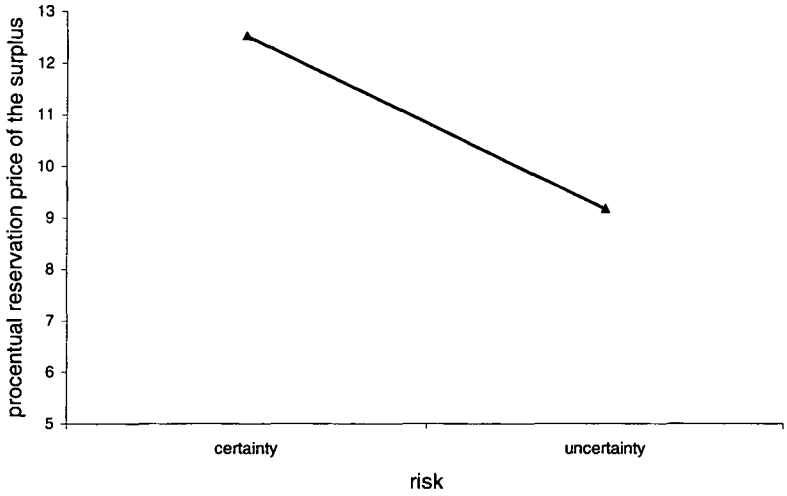

Figure 7: Different results when a same surplus (1,000 euros) given under certainty and uncertainty $F(1,76)= 4.13, p < .05$

3.4. *Survey F*

Experiment *F* was constructed along the lines of the previous surveys. Again, each subject (N = 62) was informed that she was one of five partial-right holders of a unitary resource and that a third party was looking to purchase all five parts. Every individual part was valued at 50 euros. If the purchaser was successful at rebundling the five parts, he would obtain a surplus in a range between a minimum and a maximum expected value. In a random order, the six trials indicated an expected surplus between respectively 100–500, 1000–5000 and 10,000–50,000 in the different trials. This experiment differs from section 3.3. because the exact probability and payoff from bundling remains unknown. The knowledge of subjects was restricted to the range within which the profits were situated. This experiment is more realistic because, as in real-life situations, precise probabilities remain unknown. For instance, when a real estate developer seeks to purchase five adjacent tracts, it is more likely that the land owners base their initial reservation prices on a rough, highly subjective estimate of the value to the entrepreneur, rather than probability and profit estimates of the individual provided to subjects in surveys *D* and *E*.

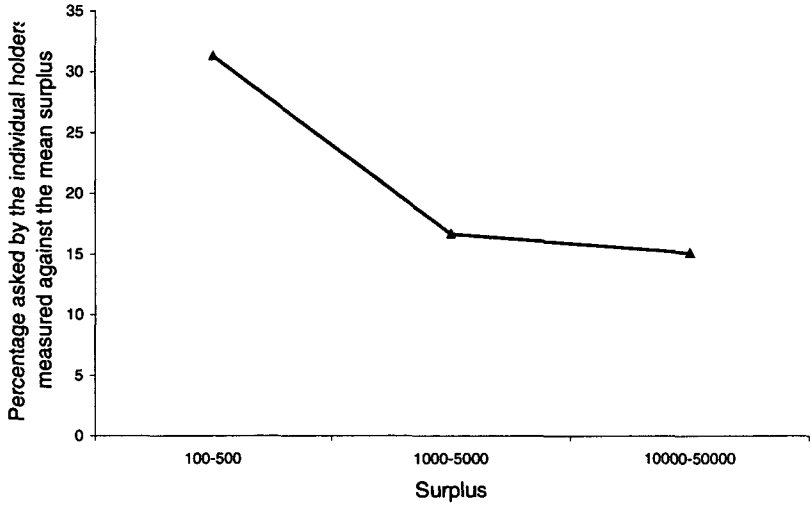

Figure 8: The expected profit of bundling the fragmented property for the holder's purchaser under the uncertainty about the amount of the surplus. ($F(2,60) = 4.15$, $p < .05$)

When the surplus was situated in the 100-500 dollar range, the individual owners demanded 32%, or eighty-three euros, of the average surplus of 300. The average reservation price was 415 euros. With regard to the higher profit ranges, the average reservation price was 17.5% of the average surpluses of 3000 and 30,000. Again, two observations appear. First, participants employed an all or nothing strategy, demanding relatively high prices, when stakes were minor.[27] Secondly, when stakes were high, subjects' reservation prices were based on a proportion of the expected profit of the buyer, irrespective of objective market value of an individual part.

4. DISCUSSION

4.1. *Survey A & B: Complementarity*

In survey *A* and B, we measured the magnifying effect of complementarity of fragmented property entitlements on the occurrence of anticommons losses.

[27] The wider variance within this cell suggests that this finding possibly is a confound resulting from the low values.

Prior theoretical research on anticommons fragmentation claims that the severity of the deadweight losses from concurrent possession of complementary rights increases monotonically with the number of independent holders: "The greater the number of individuals who can independently price an essential input, the higher the equilibrium price that each of these individuals will demand for his own license. At the margin, as the number of [right] holders approaches very large numbers (or infinity), complete abandonment of valuable resources will result."[28]

While reservation prices for "2 out of 5" complementarity totaled 34% over the objective value, a case of strict "5 out of 5" complementarity averaged a combined demand price that was 100% above the objective value. These simple findings confirm the theoretical findings that reservation prices correlate with the strength of veto-right into the successful bundling of the individual parts.

These basic results of surveys *A* and *B* are not surprising. Selling prices are higher when a seller has more individual bargaining power.

4.2. *Survey C: Reservation Prices and the Size of the Pie*

Experiment *C* examined the influence of higher degrees of profitability on the reservation prices of the individual right holders. Contrary to surveys A and B, we now disclosed the gains from bundling in order to measure the effect on reservation prices. Furthermore, we contrasted situations where reunification of fragmented parts resulted in very substantial profits with situations where reunification created very modest gains. The results give little reason to believe that, from the perspective of uncoordinated selling prices, the problem is less pronounced when opportunity costs are higher, i.e. when the costs of idleness or under use are more pronounced. The results indicate that, with regard to initial reservation prices, respondents do not discriminate between projects of rebundling that are very profitable and cases that generate more modest payoffs. As illustrated in *Figure 2* above, there was no significant difference of reservation prices in the profit range between 300 and 10,000 euros: the average price stated by each of the right holders was approximately 26% of the total value of the surplus attained by bundling. In the case of a surplus of 10,000 euros, the purchaser was faced with an aggregate mean asking price of 12,300 euros. This price was 24.6% above the price that he could offer so that the project remained profitable. Similarly, when the profit from bundling was only 300 euros (plot 2 on graph 2, a median asking price was 26.6% or 79.8 euros per part), the combined reservation price was 399 euros. Thus, the difference in reservation prices between a surplus of 300 and 10,000 is non-significant.

---

[28] Depoorter & Parisi, *supra* note 9, at 460-61.

The implication is that, in attempting to rebundle subdivided parts, a third party purchaser faces reservation prices that significantly outweigh the expected profitability of the attempted reunification, regardless of the size of the interest at stake. All else being equal, a third party with a highly profitable project or with a more modest project, faces prices that are, more or less to the same extent, beyond the expected value of the project. An oil company seeking to acquire four adjacent parcels of land for the purpose of optimal drilling, with a potential for efficiency savings of 2 million euros, faces a negotiation problem comparable to an editor trying to assemble the copyrights from four different authors for an anthology on American writing (with profitability of 1000 euros). This confirms the findings of Libecap and Wiggins that unitization of oil fields, involving multiple right holders, might fail despite the tremendous gains that can be reaped by uniting oil fields.[29]

This survey indicates that subjects hold a certain amount (approximately 25%) of the profit as a focal point as to what they deem to be the price at which they are willing to sell their individual part. Regardless of any endogenous motivation for this proportion (evaluations of fairness, etc.), five people are each asking a combined price that exceeds the expected benefits of bundling by 25%.

4.3. *Survey D & E: The Role of Uncertainty*

Next, we measured the effect of uncertainty regarding the expected benefits of the bundling of fragmented property entitlements. Surveys *D* and *E* compare conditions: 1) where there was considerable uncertainty regarding high returns; and 2) where there was relative certainty, but with a chance of losses for the third-party purchaser. The expected value was identical in both conditions.

4.3.1. High Degrees of Uncertainty with Large Upside

From the results, it follows that subjects consistently demanded a proportional share of 10% of the maximum profit that could possibly be realized by bundling. The mean reservation price, set by one individual right holder, was 14.25% of the surplus (see *Figure 3* above). In our results, aggregate reservation prices were seven times above the expected value of the project.

These results indicate that subjects ignored the expected value of the purchaser's project, and instead focused on the most optimistic outcome of

---

[29] *See* Gary D. Libecap & Steven N. Wiggins, *Contractual Responses to the Common Pool: Prorationing of Crude Oil Production*, 74 AM. ECON. REV. 87 (1984).

the scenario. This expectation leads to higher demands from right holders than in the previous surveys. Pricing decisions seem to be anchored on the maximum payoff that the third party purchaser might obtain by bundling, rather than the expected value of the project. Subjects seem to take the most positive outcome of bundling as a focal point for the division of surplus with the purchaser. From the manipulation check, it seems that respondents were making a conscious choice rather than being confused about the expected value of bundling.

In the aggregate, however, this is a gloomy outcome. The focus of right holders on the optimistic outcome of the scenario imposes a heavy burden on the third party acquirer. The third party will need to negotiate in order to drive the initial reservation prices down to a price level that is below 50% of the initial stated price. Prior experimental research has demonstrated that initial selling prices are sticky, i.e. they influence the outcome of negotiations.[30] In the advent of these bargaining costs, projects with uncertainty have a higher chance of failing, by placing such considerable burden of negotiation on those engaged in high risk projects. The prospect of such high demands by complementary right holders may lead projects that involve higher degrees of uncertainty to be forsaken, despite positive expected values.

These findings are particularly relevant for the domain of patent law. Intrinsically, the development of medical products from broad inventions involves a high risk of uncertainty—history has demonstrated that the path of innovation is unpredictable.[31] In this area, substantial investments in research and development provide no guarantees. When the risk of research and development is high and is not accounted for in the licensing prices of upstream patents, medical research may be biased towards low-risk enterprises.

On a general level, the profits obtained by bundling the individual parts can be conceptualized as a commons. As individual right holders, each has a veto right to the third party's project of bundling these resources.

---

[30] Anthony N. Doob et al., *Effect Of Initial Selling Price On The Subsequent Sales*, 11 J. PERSONALITY & SOC. PSYCHOL., 345-50 (1969). A number of field experiments investigated the effect of an initial selling price on subsequent sales of common household products. The results are consistent with dissonance theory in that subsequent sales prices track initial prices.

[31] A major historical example of the difficulty of getting an accurate estimation of the expected value of inventions is IBM's underestimation of the future market of home computers. *See* Robert P. Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 62 TENN. L. REV. 75, footnote 41 (1994) (*citing* NATHAN ROSENBERG, EXPLORING THE BLACK BOX: TECHNOLOGY, ECONOMICS AND HISTORY 220 (1994)): 'The computer was regarded by its inventors as a purely scientific device . . .' (*quoting* Barbara G. Katz & Almarin Phillips, *The Computer Industry, in* GOVERMENT AND TECHNOLOGICAL PROGRESS 162, 171 (Richard R. Nelson ed.,1980)). *See also* JON ELSTER, *EXPLAINING TECHNICAL CHANGE* 111 (1983); JOEL MOKYR, THE LEVER OF RICHES: TECHNOLOGICAL CREATIVITY AND ECONOMIC PROGRESS 154 (1990); CHRISTOPHER FREEMAN, THE ECONOMICS OF INDUSTRIAL INNOVATION 75 (2nd ed. 1982).

As with over-harvesting of common resources, uncertainty about the size of a commons leads to lower levels of cooperation. In our anticommons findings, higher degrees of uncertainty regarding the profitability of the project lead to higher demands by the stakeholders. In the face of these increasing demands, projects with higher uncertainty (even if they have identical expected values) are more likely to be forsaken as right holders demand more on an individual basis, while expecting that others will demand more.[32] This result aligns with research on common resource dilemmas where levels of cooperation are reduced when there is more uncertainty as to the size of the common pool.[33]

4.3.2. Low Degrees of Uncertainty with Large Downside

Experiment *E* measures prices under situations where the purchaser/entrepreneur faced a high probability of modest gains, but there was also a modest risk of a more substantial loss (*low risk-low profit model*).

Although the expected values of each of the several scenarios were identical, reservation prices were consistently lower in cases with a large uncertainty regarding the size of the (strictly) positive outcome than in cases with relative certainty but with a modest chance of a negative outcome (See *Figure 6* above). A possible explanation for this result is that subjects emphasized the relative low probability of success in *D* over the possibility of a negative outcome in *E*.

According to the well-known framing effect,[34] it is assumed that individuals adopt different reference points as decision outcomes are framed differently. Similarly, our results illustrate the influence of the

---

[32] *See* David V. Budescu & Amnon Rapoport, *Generation of Random Binary Series in Strictly Competitive Games*, 29 BULL. PSYCHONOMIC SOC'Y 530 (1985). David Budescu et al., *Simultaneous vs. Sequential Request in Resource Dilemmas with Incomplete Information*, 80 ACTA PSYCHOL. 297 (1992); David Budescu et al., *Common Pool Resource Dilemmas Under Uncertainty: Qualitative Tests of Equilibrium Solutions*, 10 GAMES & ECON. BEHAV. 171 (1995).

[33] Kopelman et al., *supra* note 12, at 125-27.

[34] The prototype of a framing task is the Asian disease problem. Participants are told about an epidemic of Asian flu, which is expected to kill 600 people in the USA. They then have to choose between two options: option A saves 200 people with certainty; option B saves all 600 people with probability $p = 1/3$ or nobody. Options A and B are framed as gains. Options C and D introduce a negative framing. By implementing option C, 400 people will die for sure, and by implementing option D all 600 people will die with probability $p = 2/3$ or nobody will die. Although each of the options have an identical expected value (in terms of lives saved), it is attributed to the framing effect that participants prefer option A (the sure option) over B (the risky option) in the positive framing condition, and prefer option D (the risky option) over C (the sure option) in the negative framing condition. *See* Daniel Kahneman & Amos Tversky, *Prospect Theory: An Analysis of Decision Under Risk*, 47 ECONOMETRICA 263 (1979); Amos Tversky & Daniel Kahneman, *The Framing of Decisions and the Psychology of Choice*, 211 SCI. MAG. 453 (1981).

communicated frame by the bundler. Although the expected value from bundling in survey *D* and *E* were identical, reservation prices were lower when the expected value was denoted solely in terms of gains. There are a number of possible interpretations of this outcome. The results parallel the findings of de Dreu, et al., that individual right holders are less likely to make concessions when the payoffs of the third party are conceptualized from a loss perspective.[35] In our experiment, subjects seem to be more mindful of uncertainty with regard to gains than losses.[36] Put differently, in considering the price at which they would sell their rights, sellers disregarded potential losses of the purchaser; however, they seemed more willing to lower the price to take into account potential profits. The tendency of right holders to decrease reservation prices when the reference-outcome was strictly positive, suggests a higher willingness of individual right holders to cooperate when a project is termed solely in terms of positive payoffs. Alternatively, the added complexity in the aggregate calculation of expected values involving positive and negative outcomes might lead to more exaggerated demands because of the stronger non-calculative nature of collective decision making in those instances.[37]

5. CONCLUSION

Over the past three decades, economists, psychologists, philosophers, and political scientists have conducted intensive research on social dilemmas. Such research has demonstrated that social dilemmas, such as public good and prisoner's dilemmas, are very context specific.[38]

---

[35] *See* Carsten K.W. de Dreu et al., *Effects of Gain-Loss Frames in Negotiation: Loss Aversion, Mismatching, and Frame Adoption*, 60 ORGANIZATIONAL BEHAV. & HUMAN DECISION PROC. 90 (1994).

[36] The adoption of a positive or negative frame has empirically been found to affect the outcome of dyadic negotiations. Such frames may influence the outcome of further negotiations. For example, negative framing induces greater risk seeking so that negotiators with a negative frame make fewer concessions and more often fail to reach agreement than negotiators with a positive frame. Max H. Bazerman et al., *Integrative Bargaining in a Competitive Market*, 345 ORGANIZATIONAL BEHAV. & HUM. DECISION PROCESSES 294-313 (1985); William P. Bottom & Amy Studt, *Framing Effects and the Distributive Aspects of Integrative Bargaining*, 56 ORGANIZATIONAL BEHAV. & HUM. DECISION PROCESSES 459 (1993); Margaret A. Neale & Max H. Bazerman, *The Effects of Framing and Negotiation Overconfidence on Bargaining Behaviors and Outcomes*, 28 ACAD. MGMT. J. 34 (1985).

[37] *See* Peter Colett, *The Rules of Conduct, in* SOCIAL RULES AND SOCIAL BEHAVIOUR (Peter Collett ed., Oxford: Basil Blackwell 1977) (Individuals often seek fast and satisfactory solutions rather than rational consideration of all choices.).

[38] Peter Kollock, *Social Dilemmas: The Anatomy of Cooperation*, 24 ANN. REV. SOC. 183, 185 (1998).

In this contribution, we addressed the specific elements of anticommons dilemmas, while deferring the interesting research task of contrasting commons and anticommons dilemmas.[39]

The "Tragedy of the Anticommons" is a social dilemma where veto rights are exercised even when the use of the common resource by one party could yield net benefits for all parties involved. This experiment explores how, when a common resource is subject to multiple exclusion rights held by two or more individuals, these co-owners may withhold these rights from other users to an inefficient level.

A number of conclusions can be drawn from the experiment:

1. Our results confirm the theoretical proposition that anticommons deadweight losses increase with the degree of complementarity between individual parts, and with the degree of fragmentation. This paper illustrates the pricing effect of the anticommons. The results in experiments *A* and *B* clearly show a positive correlation between the amount of the surplus demanded by the individual property right holders and (i) the degree of complementarity of individual parts into the buyer's project (*A*); and (ii) the number of individual right-holders (*B*).

2. Individual right holders base their reservation price on a proportion of the expected surplus of the bundler-purchaser. They disregard the objective value of the good altogether. In one instance (experiment *C*), the purchaser faced *five* sellers each of who each demanded *25%* of the expected value of his project.

3. In cases of uncertainty, the anticommons dilemma becomes more pronounced. In experiments *D* and *E*, pricing decisions seem to be anchored on the maximum payoff the third party purchaser might obtain by bundling, while disregarding the expected value of the project. Subjects seem to take the best possible result of bundling as a focal point for the division of surplus with the purchaser. In Experiment *D*, this focal point led to a total reservation price that was seven times beyond the expected value of the project. The extremely high reservation price created a serious gap between what individual right holders were asking, on the one hand, and what a third party entrepreneur could reasonably offer.

Another, more subtle response to uncertainty emerges from the comparison of experiments *D* and *E*. When deciding the price at which they will sell their rights, sellers seem to disregard potential losses of the purchaser, while they were more willing to take into account uncertainty with regard to profits. The tendency of the right holders to decrease reservation prices when the reference-outcome is strictly positive, suggests

---

[39] Elsewhere, we have investigated the empirical and theoretical question on the symmetry between commons and anticommons dilemmas. *See* Sven Vanneste et al., *From 'Tragedy' to 'Disaster': Welfare Effects of Commons and Anticommons Dilemmas*, 26 INT'L. REV. L. & ECON. 104 (2006) (Finding that anticommons situations generate greater opportunistic behavior and a greater risk of under use compared to equivalent commons dilemmas.).

a higher willingness of individual right-holders to cooperate with projects termed solely in terms of gains (see *Figure 6*). Subjects seem to emphasize the relative low probability of success in *D* over the possibility of losses in the survey *E*.

4. When stakes are minor, the individual right holders state disproportionately high reservation prices—35% in the case of a project with expected value of 100 euros. Where stakes are higher, the average reservation price remains relatively stable at 14-19% of the expected surplus. This all-or-nothing strategy surfaces throughout the various experiments.

* * *

To summarize, our experiment indicates the pricing effect in settings where complementary units are fragmented over individual right-holders. Absent price coordination among these right holders, the independent pricing decisions place a high negotiation burden on a third-party purchaser.

Our experiment leaves the dynamics of negotiations among fragmented owners to further research.[40] However, the results provide a proxy for the burden of negotiation placed upon the shoulders of a buyer who seeks to rebundle independently-owned property fragments. The results also provide an indication of the extent of the price concessions that a prospective seller will need to obtain to bring the price of bundling within the limits of the net expected value of bundling. If we assume initial selling prices are sticky,[41] the prospective costs of negotiations might lead to abandonment of value maximizing projects, leading to the tragic outcome of under use or idleness.

In this regard, our results reinforce the normative hypothesis of the anticommons: property right systems should be careful in allowing the

---

[40] *See*, Robyn M. Dawes et al., *Cooperation for the Benefit of us—Not me, or my conscience, in* BEYOND SELF-INTEREST (Jane J. Mansbridge ed., 1990) (discussing the impact of discussion and interaction in enhancing cooperation in social dilemmas).

[41] When the height of reservation prices is due to the attribution effect, it is likely that price concessions will be hard to obtain. Cognitive psychology documents peoples' inclination to discount new evidence that conflict with their prior beliefs (belief perseverance). According to confirmatory bias, people tend to misconstrue or misinterpret information, so that it becomes additional information that supports the initial hypothesis. The initial experiments include John M. Darley & Paget H. Gross, *A Hypothesis—Confirming Bias in Labeling Effects*, 44 J. PERSONALITY & SOC. PSYCHOL.. 20 (1983) (establishing that identical additional information is interpreted differently because of prior beliefs or backgrounds); Matthew Rabin & Joel L. Schrag, *First Impressions Matter: A Model of Confirmatory Bias*, 114 Q. J. ECON. 37 (1999) (providing a formal model demonstrating how confirmatory bias may induce overconfidence).

liberal creation of new property rights and fragmentation of existing property rights.[42]

42 *See* Francesco Parisi, *Entropy in Property*, 50 AM. J. COMP. L. 595 (2002).